

Response to Peer Review Comments
Total Maximum Daily Load for Organochlorine Pesticides, Polychlorinated Biphenyls, and Siltation in Calleguas Creek, its Tributaries, and Mugu Lagoon

1. Peer Review of Calleguas Creek Watershed Organochlorine (OC) Pesticides and Polychlorinated Biphenyls (PCBs) TMDL, Neal E. Armstrong, Ph.D., Provost, University of Texas
2. Peer Review of Technical Component of the Mugu Lagoon Siltation TMDL, Neal E. Armstrong, Ph.D., Provost, University of Texas

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01	Dr. Neal E. Armstrong / OC Pesticides and PCBs	06/02/05	Soundness of Scientific Knowledge, Method , and Practices Many areas of the watershed were 303(d) list based on assessment guidelines, the TMDL did not identify any OC pesticides or PCBs causing toxicity in water or sediment; thus, the connection between constituents and their effects is not clear	This TMDL addresses the full range of concerns associated with OC pesticides and PCBs beyond toxicity including bioaccumulation, persistence, and sediment targets in spite of the fact that the connection between constituents and their effects is not perfectly understood. Concerns relating to toxicity are also addressed in the CCW Toxicity TMDL.
			This TMDL was performed without consideration of confounding water quality problems that could overshadow the toxic effects of the OC pesticides and PCBs.	Staff disagree. Numeric targets in addition to water column toxicity targets are used to ensure protection of beneficial uses. A conservative approach was used to identify potential areas of impairments. The implementation plan including special studies, sources control activities, BMPs, and a monitoring program is prepared to identify undefined sources and to reduce active sources of OC pesticides and PCBs to meet water quality objectives.
			In a TMDL such as this with constituents that are infrequently	Staff agree. Special studies included in the implementation

* For a complete version of comments, please refer to the attached comment letters

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			detected, that are decreasing in concentration in the study area over time, and that have not been shown to be causing apparent harm to the biota in the watershed, a conservative approach is needed to identify potential areas of concern and the approaches and costs for the remediation so that rational decision may be made about the implementation of the TMDL.	plan will examine degradation rates, food web effects, and bioaccumulation. Additionally, a provision is included in the TMDL to allow for reevaluation of WLAs and LAs, if results of special studies and/or monitoring indicate allocations are inappropriate.
			There is a paradox that perhaps further sampling and analysis will explain. The DDE loads to the tributaries from point and non-point sources are estimated to total 32.9 lbs/yr (Table 52) and the DDE loads to Mugu Lagoon from Calleguas Creek and Revolon Slough are estimated to be 9.1 lb/yr (Table 54), although it appears it should be 9.4 lb/yr (6 lb/yr from Revolon Slough and 3.4 lb/yr from Calleguas Creek). This would imply that 23.8 lb/yr remain in the tributaries and that only 28% of the point and non-point source load is transported to Mugu Lagoon. If this is the case, then there should be a build-up of DDE in the tributaries and almost certainly in the sediment. Yet, Figure 2 shows a long-term decrease for sediment DDE in the tributary. Since DDE is primary associated with sediments, one would also expect a significant long-term buildup of sediments in the tributaries given the imbalance between DDE loads to the tributary and DDE transport downstream, yet that is contrary to fluvial dynamics in a tributary like this in which overall erosion and loss of sediments via transport	Notes taken. The technical report document has been revised. Estimates of DDE loading in water (dissolved + particulate) made according to land-use-specific water data yield significantly different values than estimates made according to in-stream data. The results of special studies and monitoring will address this issue. Staff also agree that Mugu Lagoon may be a sink for DDE and the siltation portion of this TMDL addresses sediment load reductions, and thereby OC Pesticides and PCB reductions.

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			<p>downstream is expected. This would suggest that there is a sink for DDE which is not yet factored into the mass balance, and the mechanism for that loss can be decay of the DDE, transport of DDE-laden sediments downstream, or both. The authors suspect that significant transport of DDE is occurring during wet weather events, and the water column DDE concentrations in Table 56 suggest that. It is not clear, however, if these water column concentrations are dissolved phase, particulate phase, or total water concentrations for DDE. If they are indeed dissolved phase concentrations, then there is a significant amount of DDE on the suspended sediment which was not measured. During wet weather events, one can expect significant transport of sediments scoured from the stream bed and with those sediments there would be significant DDE transport. It may well be that wetweather transport in the stream itself accounts for enough transport to remove far more DDE from the watershed than has been calculated. On the other hand, Table 55 indicates that the lower estimate for half-life (or time for 50% decrease in concentration) of DDE is 1,000 days (or 2.74 yrs); the loss rate of sediment DDE shown in Figure 22 is close to that half-life. From this field data, it appears that natural decay could be accounting for the loss of DDE on the sediments and that the 28% of DDE entering the tributaries and being transported to Mugu Lagoon represents the remaining DDE after decay processes have reduced its concentration on</p>	

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			the sediments.	
			<p>The Linkage Analysis in Section 6 is a good conceptual approach, but there are some fundamental errors in both concepts and models that must be addressed. First, the authors state (p 82) that numeric targets for OCs in fish tissue define acceptable levels for protection of human health and wildlife, while numeric targets for water and sediment protect lower trophic level organisms and help trace impairment in biota back to sources. It is true that there are guidelines for fish tissue concentrations that will pose a hazard to human health if the tissue is consumed in large enough quantities for a long enough period of time, but there are also fish tissue concentrations determined to be hazardous to the health of the fish. These should not be confused. Further, there are concentration of OCs in water that are lethal or sublethal to fish; the bioassay literature from the 1950s forward and particularly the development of toxic material concentrations for aquatic life are based on toxicity testing data for fish and invertebrates; thus, numeric targets for OCs in water and sediment are not limited to lower trophic level organisms. The basic assumption of the TMDL analysis made by the authors, which is that actions to reduce OC concentrations in sediments will reduce OC concentrations in fish tissue and in the water column, is not a bad assumption, but the assumption about the roles of the numeric targets is.</p>	<p>Language in Technical Report which discusses the role of selected numeric targets (p.82) has been modified to read “The numeric targets selected for OCs in fish tissue, water, and sediments define acceptable levels for protection of human health, fish, benthic organisms, and wildlife.”</p>

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			There is a serious misconception about bioconcentration vs. bioaccumulation found on page 84.	Note taken. The Technical Report has been revised . The term ‘bioaccumulate’ was used, when the term ‘bioconcentrate’ should have been employed. Changed per comment.
			The statement on page 82 that “The primary removal mechanism of OCs from the watershed is by flushing to the Pacific Ocean via Mugu Lagoon” is not substantiated by any data presented in the TMDL. This may be happening, but the sediments in the Lagoon need to be examined and the mass of DDE in them estimated to determine what sediment (and hence DDE) trapping is occurring in the Lagoon. What trapping is occurring is most likely leading to permanent burial of the DDE and other OCs in the sediments.	Staff agree. See revised technical support document.
			It would help to have some estimate of the amount of fish and shellfish taken from the watershed and consumed by recreational fishermen so that something close to actual consumption rates may be used in the equations used to determine human health water quality targets. Thus, a proportionality factor may be used, but the magnitude of this proportionality factor is not addressed. It is highly likely, however, that human health water quality criteria based on consumption of non-carcinogens at food consumption rates likely to occur for fish and shellfish taken from Calleguas Creek and Mugu Lagoon are far higher than those used as targets in this TMDL.	During the process of developing the OCs TMDL, the idea of conducting a study to estimate the amount of fish and shellfish consumed by humans in the CCW was considered. Due to logistic challenges and budget limitations, the study was not conducted. Given the relatively low rates of consumption by humans suspected to occur in the CCW (based on field observation and anecdotal evidence), human health water quality criteria used for this TMDL are protective and appropriate.

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			<p>The second linkage is between fish tissue OC concentrations and OC concentrations in sediments. While this conceptual linkage has merit and the use of the BAF to relate OC sediment concentrations via water OC concentrations to fish tissue OC concentrations also has merit, relating the BAF to sediment OC concentrations as depicted in Figure 24 does not have merit. As noted earlier, the BAF represents the fish tissue OC concentration compared to the OC concentration in water after passing through the food chain and after accounting for bioconcentration. It accounts for the various uptake and depuration processes that occur in organisms and, except for the filter feeders, relies primarily on organisms in the food chain being exposed to water rather than sediment, whether it is water in the water column or pore water. Even the filter feeders recover only a portion of the OCs from the sediment consumed, meaning that sediment OC concentrations cannot be assumed to be totally assimilated. With the concentration of sediments in the sediment layer and the hydrophobic nature of the OCs, the pore-water concentrations while high are perhaps a few percent at most of the sediment OC concentrations. Therefore, the relationship between OC in the sediment, OC in fish, and the BAF cannot be supported. The authors note that they are developing food chain models for the watershed. They may wish to examine the food chain models discussed on pages 565-576 in Thomann and Mueller (1987);</p>	<p>The special study which examines food web dynamics and bioaccumulation will provide critical information for better understanding the relationship. The WLAs and LAs are subject to reevaluation by the Regional Board based upon findings of the study.</p>

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			this is essentially the model used by the USEPA in its toxic material implementation guide (USEPA 1991).	
			The third linkage is that OC concentrations in water are a function of OC concentrations in sediment. The authors do not make clear that the water concentration referred to is actually the particulate phase concentration. The dissolved phase concentration will be small because of the large partition coefficients for OCs, but the water concentration (or total water concentration) will be the sum of the two phases. Keeping the TSS (m) concentration low will keep the particulate phase concentration (c_p) in the water low, but it does not change the concentration of the OCs on the sediment (r). Natural processes, however, appear to be lowering r as shown in Figure 22, and that is the desired result noted on page 92.	The water concentration referred to is not particulate phase. Rather it is total water concentration (dissolved + particulate). Since most of the OC content in a given sample of water is associated with the particulate phase, total water concentrations (dissolved + particulate) will decrease with decreasing sediment concentrations. Language was added to the Technical Report to clarify this point. Further, the siltation portion of this TMDL establishes wasteload and load allocations to reduce sediment loads, and thereby OC pesticides and PCBs loads, to the watershed.
			The last linkage is that OC concentrations in sediment are a function of OC loading and sediment transport. While the authors have assumed a simplified one-box model for OC loading and sediment transport in the tributaries, it is a reasonable approach at this point because of all the unknowns documented in the TMDL. Their analysis reveals however that sediment transport estimates are needed to make the approach work. An alternate approach is the plug flow model approach for toxic materials in rivers and streams described in Thomann and Mueller (1987) on pages 522-527 and using the natural decay rates	Note taken. The Implementation Plan contains a special study to address uncertainties in sediment transport.

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			discussed above. This model assumes a fixed sediment bed, although enhancements of this approach in USEPA-supported mathematical models like WASP do include sediment transport as well. Calibrating such models, however, is difficult, and its use is not warranted here at this time.	
			<p>Specific Issues:</p> <ul style="list-style-type: none"> - Validity of Using a 1:1 Linear Relationship Between Water, Sediments, and Fish Tissue <p>The numerical targets for fish tissue and water concentrations to protect human health used herein are the wrong targets because they do not reflect conditions in the watershed. Further, the BAF could represent in a proportional relationship the ratio of OC concentrations in fish to OC concentrations in sediments via OC concentrations in water which are in equilibrium with the OC concentrations in sediments through sorption/desorption processes. It is not clear, however, that the BAF represents this ratio numerically as suggested by the equation in Figure 27. The BAF cannot be equated to the ratio of the OC concentration in water and the OC concentrations in sediment as shown in the same figure; that is a sorption/desorption partition coefficient relationship.</p> <p>The validity of using a 1:1 linear relationship between water, sediments, and fish tissue is a different matter. These relationships</p>	Figure 27 in the Technical Report has been revised per comment (BAF used to describe fish:sediment, and partition coefficient used to describe water:sediment). A special study included in the Implementation Plan will examine the validity of the 1:1 relationship, and WLAs and LAs reevaluated if necessary.

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			<p>can be stated mathematically as Thomann and Mueller (1987) have done, and as long as the relationships are linear then there is a proportional reduction in fish or water OC concentrations with reduction in sediment OC concentrations. Whether it is a 1:1 relationship is not clear at all and would require applying those equations to Calleguas Creek to confirm such a relationship.</p> <p>Assuming that a percent reduction in OC concentrations in fish or water is produced by an equal percent reduction in OC in sediments cannot be supported with the analysis presented.</p>	
			<p>- Validity of Using an Implicit, Rather Than an Explicit, Margin of Safety</p> <p>...A conservative approach needs to be taken not only in assuming an initial large Margin of Safety but also in how constituent control measures are selected and phased in. This conservative approach with an assumed initial large Margin of Safety was implicitly incorporated into the TMDL through the assessment guidelines used as the basis for 303(d) listing and later using more restrictive numerical targets to specify goals for the TMDL.</p>	Staff agree that the implicit margin of safety is appropriate
			<p>- Validity of Selecting DDE as a Representative Constituent for the Linkage Analysis</p>	Staff agree that selecting DDE is appropriate
			<p>Clarifications needed</p> <p>Table 4 Text needs to state definitions of abbreviations in Remaining Beneficial Uses portion of table</p>	Note taken. See revised technical support document.

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			Table 5 Tissue level units should reflect whether Kg tissue is wet or dry weight Table 6. The water quality level used to determine percent exceedances for 4,4'-DDT is never given. Also not given is whether these are total, dissolved, or particulate water concentrations.	Note taken. Table 5 revised per comment to show that (wet or dry) is the appropriate unit. Notes taken. Information not available at this time because different monitoring programs used different sampling and reporting protocols.
02	Dr. Neal E. Armstrong / Siltation	06/24/05	Overview: The authors have done quite a commendable job of synthesizing the available siltation data for Mugu Lagoon and sediment transport data for the Calleguas Creek watershed. They have identified data gaps and developed an adaptive management approach including a research component with guidance from a Science Advisory Panel to determine additional needs and approaches.	Note taken
			Problem Statement: Perhaps the greatest need in this TMDL is to develop that conceptual framework so that different ways of estimating and representing sediment sources, the processes of sediment transport through the tributaries, and the sedimentation and compaction of sediments in the Lagoon can be interrelated. It is also important to understand the long-term and short-term changes in fluvial dynamics caused by land use changes and sediment control systems. Action that may appear to be effective in the short term in	Staff agree and expect the Special Study will address the conceptual framework of sediment origin, transport, deposition, and compaction.

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			controlling siltation may in fact in the long term be quite deleterious.	
			Current estuaries are relatively recent features geologically, created following the last major glaciation period as the sea level rose inundating riverine channels. With the stabilization of sea level in the past few millennia, the geomorphic features of estuaries have been modified by sediment loads delivered from the rivers that enter them, the sediments transported along shore to them, and the reworking of those sediments by tidal action through the opening to the ocean and flood events from the rivers. Mugu lagoon, it can safely be stated, has never been a stable system, and the geology of this system, if it is not know already, to understand how it has responded to the sediment loads historically.	In addition to fluvial processes that naturally alter coastal estuaries, staff would like to add between 1951 and 1961, the Naval Base removed sediment from the central basin area of the Lagoon (to 30' below Mean Sea Level), which dramatically increased the sedimentation rate within the Lagoon. By approximately 1998, the central basin was re-filled. The effects of these historic alterations will be studied as part of the Implementation Plan. Further, while the author correctly states that estuaries reflect a dynamic process, the rates of those processes can affect the life of the estuary and can be affected by intervention.
			The other significant need of this TMDL is to relate specifically the impacts of elevated levels of sedimentation/siltation on beneficial uses for Mugu lagoon. At his point the 303(d) listing states that there is a loss of beneficial uses; however it is possible to relate to some extent what specific relationships are between sediment concentrations and beneficial use losses is possible to some extent with available literature data. For example, there is abundant literature on the effects of siltation on Navigation. There is significant literature on the effects of siltation and suspended	Staff agree and expect the Special Study to investigate the connection between elevated sedimentation/siltation and the loss of beneficial uses in Mugu Lagoon.

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			sediment on finfish, shellfish, benthic organisms, etc. related to the Commercial and Sport Fishing, Estuarine, Marine and Wildlife Habitat, preservation of Biological Habitat, Rare, Threatened or Endangered Species Habitat, Migration of Aquatic Organisms, Spawning, Reproduction, and/or early Development and Shellfish harvesting.	
			Where estimates are available, it is not totally clear whether they include sand, silt and clay or just silt and clay or just silt. In some instances, "silt" appears to be used to represent all of the sediment rather than the portion represented by a certain size class. This interchanging of terms is confusing and in relation to fluvial dynamics will means quite different things.	The references were grouped into discussions of silt (<6mm) and total sediment (all mm), For referenced studies that reported the total sediment load, the silt portion of that sediment load was estimated and used in the Technical Components of the Mugu Lagoon Siltation TMDL Memorandum, unless total sediment was explicitly noted.
			Finally, the estimated for sediment loading using "loss of capacity" appear underestimated. Assuming that 'loss of capacity' in this case refers to sediment build-up in the bottom Mugu lagoon and the material of concern is the sediment that displaces the water in the Lagoon and the water being displaced, the bulk density (mass of sediment plus water/volume) of 1000 kg/m3 significantly underestimates the amount of sediment load needed to produce that loss of capacity.	Staff agree that sedimentation rates based on density may be too underestimated, but the most recent studies used this value. Many different approaches, including the one proposed, could be used to select a value. The TMDLs adaptive management approach is based on an initial minimal load reduction that will be verified through Special Studies.
			<u>Linkage Analysis:</u> The consequences of sediment accumulation throughout Mugu lagoon by RMS 92003) may need to be re-	Staff agree that the RMA published data may underestimate the siltation impairment. The Implementation Plan includes a

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			evaluated if the bulk density needs to be changed as noted above.	re-evaluation of the sediment WLAs and LAs.
			On page 6, it is noted that Total Suspended Solids (TSS) may be the measurement by which silt reduction in the upper reaches may be monitored. The test also mentions that the USGGS gauge near the University rating curve predicted certain TSS values. Confirmation is needed that these are indeed TSS measurements, because the USGS uses a Suspended Sediment (SS) measurement rather than TSS.	Staff appreciate the comment, but is referencing information contained in other documents. Future use of USGS gauge information will clarify the measure. The Executive Officer has discretion to approve TMDL monitoring program to include both TSS and settleable solid
			<u>Critical Conditions:</u> As stated on page 7, the critical conditions for this siltation TMDL considers both of wet and dry periods. The authors may wish to review a just-published article by Zhang and Yu (2005) on the TMDL Critical Condition. Zhang, a principal engineer with Parsons Corporation in Fairfax VA and Yu, professor emeritus at the University of Virginia, suggest that a low-flow analysis method using steady-state models be used for dry weather conditions because such models are simple and well established. For wet weather conditions, however, they recommend an event-based critical flow-storm approach because the approach: (1) explicitly addresses the critical condition as a combination of stream flow, magnitude of storm event, and initial watershed condition; (2) offers the ability to estimate the risk and return period – thus, the nonpoint source management plan could be linked with its corresponding	Staff agree that a definition of critical conditions would be desirable and is best developed by the Special Study as WLAs and LAs are refined.

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			return period to determine the reasonable assurance of the TMDL implementation; and (3) is an event-based approach which is less data intensive. They also note that current research shows that the critical flow-storm concept will be more pronounced for urban and smaller watersheds.	
			<u>Margin of safety:</u> Several clarifications are needed for the margin of safety given in Table 6. First, the silt numeric target is given as 5,200 tons/yr reduction; is this in fact the case? Is not the estimated load being reduced to 5,200 tons/yr and the Margin of Safety comes from the conservative nature of the value.	<p>The total load and wasteload allocation is 5,200 tons/yr reduction of sediment delivered to Mugu Lagoon. This allocation of 5,200 tons/year sediment reductions is based on an estimate of the recently measured loss of capacity, increased sediment drape and loss of potential area for benthic habitat. Removing this amount of sediment each year could result in a balance between incoming and outgoing sediment and stabilization of the lagoon geometry. While a greater decrease, including the ones proposed by the commenter could eliminate siltation problems they could also lead to short-term erosion of habitat and would not be recommended without additional studies.</p> <p>The Margin of safety discussion includes other aspects of the analysis which provide room for error.</p>
			Allocations: At the beginning of this section, the same confusion as noted above under Margin of Safety is found, i.e. the 5,200 tons/yr	Staff agree that a larger allocation and larger reductions may well be justified. However, in this TMDL's adaptive

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			is a target that loads will be reduced to rather than being a load reduction of that amount. This needs to be clarified.	management plan, the initial reduction is estimated to be based on a measured loss of capacity, and is considered an appropriate initial reduction.
			Clarifications	Staff agree with the comments as listed, with the exception of a change in the density of the sediments as discussed under comment 4 above.